Using Clickers in the Classroom

Grace Goschke – biology
Naresh Sen – physics
CTLT brown bag talk
January 22, 2015
• Small (30-50 students) Classes – Naresh Sen
• Large (>100 students) classes – Grace Goschke
Audience composition

You are affiliated with
A. College of Engineering
B. Economics/ Orfalea School of Business
C. School of Arts & Languages
D. College of Science and Math
In a traditional (non-clicker) 1-hour class of 50 students, the total number of students who are actively engaged – ask questions, answer questions, etc. (not just listen & take notes) is:

A. 0-6
B. 7-12
C. 13-18
D. More than 18
Why use ‘clickers’?

• Actively engage MOST students by positing conceptual questions that
  – students discuss in small groups – peer instruction
  – respond individually using clickers

• Gives immediate feedback to students on their learning, and to instructor as well
Example of CQ in class with 36 students (<48 total) shows 
(1) Large % of active engagement, (2) immediate feedback

CktCT -16.

The light bulbs in the circuit are identical. When the switch is closed, 
A: both go out. 
B: both stay the same 
C: the intensity of light bulb B increases. 
D: the intensity of light bulb B decreases. 
E: both bulbs burn out due to infinite (very large) current
Why use ‘clickers’?

• Learning by doing → Enhances concept understanding and retention

• Clicker responses of individuals are NOT known to the rest of the class → students are more comfortable participating in class
CT2-9. A ball is thrown straight upward. At the top of its trajectory, its acceleration is.. 

A: zero 
B: straight up 
C: straight down 
D: depends on the mass of the ball 

(draw motion diagram, \{x,v,a\} vs t graphs)
% of PHYS 122 students that get the correct answer to this CQ is

A. More than 90 %
B. 70 – 90 %
C. 50 – 70 %
D. 30 – 50 %
E. Less than 30 %
CQ2: traditional 121; interactive 122

PHYS 121 CQ on 1\textsuperscript{st} day of PHYS 122

% of PHYS 122 students that get the correct answer to this CQ is

A. More than 90 %
B. 70 – 90 %
C. 50 – 70 %
D. 30 – 50 %
E. Less than 30 %

CT2-9. A ball is thrown straight upward. At the top of its trajectory, its acceleration is...
A: zero
B: straight up
C: straight down
D: depends on the mass of the ball
(draw motion diagram, \(x,v,a\) vs \(t\) graphs)
Actual data from 1st day of PHYS 122

CT2-9. A ball is thrown straight upward. At the top of its trajectory, its acceleration is...

A: zero
B: straight up
C: straight down
D: depends on the mass of the ball

(draw motion diagram, x,v,a vs t graphs)
PHYS 121 CQ on 1st day of PHYS 122

Actual data

**Pre-discussion vote**

**Post-discussion vote**

A glider on a tilted air track is given a brief push uphill. The glider coast up to near the top end, stops, and then slides back down. When the glider is at the highest point of its path, its acceleration is...

A: straight down
B: downward along the track
C: upward along the track
D: no direction, the acceleration is zero.

(draw motion diagram, \(x, v, a\) vs t graphs)
Interactive engagement enhances concept understanding and retention

- Learning gain \( <g> = \frac{\text{post} - \text{pre}}{\text{max} - \text{pre}} \)
- \text{red} = \text{traditional lecture}, \text{blue} = \text{interactive engagement}
Usually, clickers used in ‘large’ classes

• Common setting for clicker use is large classes, typically 100’s of students.
• Even in small classes (30-50 students), clicker responses give meaningful information

• Clickers can be effective in classes of ALL sizes typical of introductory courses
CQ examples at Cal Poly COSAM

• Large classes in Biology – GG
• Small classes in Physics – NS

• Small class CQ responses meaningful →
‘Small’ classes are not that small
How clickers typically used

• actively engage nearly all students
• serve as launching pads for extended discussions when appropriate

• EXAMPLES: Note small $N$ for these examples (enrolment is $N_{\text{total}} < 50$)
One vote shows concept (mostly) understood, so no more discussion, lecture moves on
CQ responses indicate need for further discussion

N = 36

The light bulbs in the circuit are identical. When the switch is closed,
A: both go out.
B: both stay the same
C: the intensity of light bulb B increases.
D: the intensity of light bulb B decreases.
E: both bulbs burn out due to infinite (very large) current
CQ: before and after discussion/peer instruction

‘Before’ vote launches class-wide discussion

Pre-discussion vote

N = 38

Post-discussion vote

N = 38
CQ in class with ~150 students

<table>
<thead>
<tr>
<th>Answer</th>
<th>(percent)</th>
<th>(count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer 1</td>
<td>54.55%</td>
<td>78</td>
</tr>
<tr>
<td>Answer 2</td>
<td>37.76%</td>
<td>54</td>
</tr>
<tr>
<td>Answer 3</td>
<td>3.5%</td>
<td>5</td>
</tr>
<tr>
<td>Answer 4</td>
<td>4.2%</td>
<td>6</td>
</tr>
<tr>
<td>Totals</td>
<td>100%</td>
<td>143</td>
</tr>
</tbody>
</table>

Pre-discussion vote

<table>
<thead>
<tr>
<th>Answer</th>
<th>(percent)</th>
<th>(count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer 1</td>
<td>4.83%</td>
<td>7</td>
</tr>
<tr>
<td>Answer 2</td>
<td>94.48%</td>
<td>137</td>
</tr>
<tr>
<td>Answer 3</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>Answer 4</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>Answer 5</td>
<td>0.69%</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>100%</td>
<td>145</td>
</tr>
</tbody>
</table>

Post-discussion vote
CQ in class with ~150 students

5.) Question 5

<table>
<thead>
<tr>
<th>Answer</th>
<th>Responses (percent)</th>
<th>(count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer 1</td>
<td>25.34%</td>
<td>37</td>
</tr>
<tr>
<td>Answer 2</td>
<td>44.52%</td>
<td>65</td>
</tr>
<tr>
<td>Answer 3</td>
<td>6.16%</td>
<td>9</td>
</tr>
<tr>
<td>Answer 4</td>
<td>23.97%</td>
<td>35</td>
</tr>
<tr>
<td>Totals</td>
<td>100%</td>
<td>146</td>
</tr>
</tbody>
</table>

CT2-12. A ball is fired straight downward out of a special spring-loaded gun, which produces constant acceleration. Upward is chosen as the positive direction. Assume that air resistance is negligible. Which graph properly represents acceleration of the ball?

A: Ball released from spring
B: 
C: 
D: None of these

Diagram of options: A, B, C, D
Clicker machinery – EASY TO USE

• Software for PCs and Macs free to download at www.iclicker.com
  – Zip files placed in (physics) Polylearn for easy access

• CQ software launch time in class is under 2 minutes (DEMO)

• All responses recorded
  – Very convenient and useful for later review
  – Can share with other instructors (DEMO)
Do CQs need to be written from scratch?

- NO

- Textbook has CQs in Powerpoint format with answers

- Open-source CQs available
  - Physics CQs from Univ of Colorado (zip files) placed in PolyLearn for easy download and access
Clicker machinery – GG

- Registering student roster
- Recording points and placing in Cal Poly’s Gradebook
CONCLUSION

Clickers can be used effectively in **ALL** class sizes typical of introductory courses

Some resources for ‘best practices’ of clicker use

• [http://www.colorado.edu/oit/services/teaching-learning-tools/cuclickers/help/instructor-pedagogical](http://www.colorado.edu/oit/services/teaching-learning-tools/cuclickers/help/instructor-pedagogical)

• [http://www.cwsei.ubc.ca/resources/files/Clicker_guide_CWSEI_CU-SEI.pdf](http://www.cwsei.ubc.ca/resources/files/Clicker_guide_CWSEI_CU-SEI.pdf)

• [https://www.youtube.com/watch?v=z0q5gQfQmng](https://www.youtube.com/watch?v=z0q5gQfQmng)